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Contents

List of Figures *page* xvii
List of Tables xxi
Preface xxiii

1 The Vitamins 1
1.1 Definition and Nomenclature of the Vitamins 2
1.1.1 Methods of Analysis and Units of Activity 6
1.1.2 Biological Availability 8
1.2 Vitamin Requirements and Reference Intakes 10
1.2.1 Criteria of Vitamin Adequacy and the Stages of Development of Deficiency 10
1.2.2 Assessment of Vitamin Nutritional Status 12
1.2.3 Determination of Requirements 17
1.2.3.1 Population Studies of Intake 17
1.2.3.2 Depletion/Repletion Studies 18
1.2.3.3 Replacement of Metabolic Losses 18
1.2.3.4 Studies in Patients Maintained on Total Parenteral Nutrition 19
1.2.4 Reference Intakes of Vitamins 19
1.2.4.1 Adequate Intake 23
1.2.4.2 Reference Intakes for Infants and Children 23
1.2.4.3 Tolerable Upper Levels of Intake 24
1.2.4.4 Reference Intake Figures for Food Labeling 27

2 Vitamin A: Retinoids and Carotenoids 30
2.1 Vitamin A Vitamers and Units of Activity 31
2.1.1 Retinoids 31
2.1.2 Carotenoids 33
2.1.3 International Units and Retinol Equivalents 35

2.2 Absorption and Metabolism of Vitamin A and Carotenoids 35
2.2.1 Absorption and Metabolism of Retinol and Retinoic Acid 35
2.2.1.1 Liver Storage and Release of Retinol 36
2.2.1.2 Metabolism of Retinoic Acid 38
2.2.1.3 Retinoyl Glucuronide and Other Metabolites 39
2.2.2 Absorption and Metabolism of Carotenoids 40
2.2.2.1 Carotene Dioxygenase 41
2.2.2.2 Limited Activity of Carotene Dioxygenase 42
2.2.2.3 The Reaction Specificity of Carotene Dioxygenase 43
2.2.3 Plasma Retinol Binding Protein (RBP) 45
2.2.4 Cellular Retinoid Binding Proteins CRBPs and CRABPs 47
2.3 Metabolic Functions of Vitamin A 49
2.3.1 Retinol and Retinaldehyde in the Visual Cycle 49
2.3.2 Genomic Actions of Retinoic Acid 54
2.3.2.1 Retinoid Receptors and Response Elements 55
2.3.3 Nongenomic Actions of Retinoids 58
2.3.3.1 Retinoylation of Proteins 58
2.3.3.2 Retinoids in Transmembrane Signaling 60
2.4 Vitamin A Deficiency (Xerophthalmia) 61
2.4.1 Assessment of Vitamin A Nutritional Status 64
2.4.1.1 Plasma Concentrations of Retinol and β-Carotene 64
2.4.1.2 Plasma Retinol Binding Protein 65
2.4.1.3 The Relative Dose Response (RDR) Test 66
2.4.1.4 Conjunctival Impression Cytology 66
2.5 Vitamin A Requirements and Reference Intakes 66
2.5.1 Toxicity of Vitamin A 68
2.5.1.1 Teratogenicity of Retinoids 70
2.5.2 Pharmacological Uses of Vitamin A, Retinoids, and Carotenoids 71
2.5.2.1 Retinoids in Cancer Prevention and Treatment 71
2.5.2.2 Retinoids in Dermatology 72
2.5.2.3 Carotene 72

3 Vitamin D 77

3.1 Vitamin D Vitamers, Nomenclature, and Units of Activity 78
3.2 Metabolism of Vitamin D 79
3.2.1 Photosynthesis of Cholecalciferol in the Skin 80
3.2.2 Dietary Vitamin D 82
3.2.3 25-Hydroxylation of Cholecalciferol 83
3.2.4 Calcidiol 1α-Hydroxylase 85
3.2.5 Calcidiol 24-Hydroxylase 85
3.2.6 Inactivation and Excretion of Calcitriol 86
3.2.7 Plasma Vitamin D Binding Protein (Gc-Globulin) 87

3.2.8 Regulation of Vitamin D Metabolism 87
3.2.8.1 Calcitriol 88
3.2.8.2 Parathyroid Hormone 88
3.2.8.3 Calcitonin 88
3.2.8.4 Plasma Concentrations of Calcium and Phosphate 89
3.3 Metabolic Functions of Vitamin D 89
3.3.1 Nuclear Vitamin D Receptors 91
3.3.2 Nongenomic Responses to Vitamin D 92
3.3.3 Stimulation of Intestinal Calcium and Phosphate Absorption 93
3.3.3.1 Induction of Calbindin-D 93
3.3.4 Stimulation of Renal Calcium Reabsorption 94
3.3.5 The Role of Calcitriol in Bone Metabolism 94
3.3.6 Cell Differentiation, Proliferation, and Apoptosis 96
3.3.7 Other Functions of Calcitriol 97
3.3.7.1 Endocrine Glands 98
3.3.7.2 The Immune System 98
3.4 Vitamin D Deficiency – Rickets and Osteomalacia 98
3.4.1 Nonnutritional Rickets and Osteomalacia 99
3.4.2 Vitamin D-Resistant Rickets 100
3.4.3 Osteoporosis 101
3.4.3.1 Glucocorticoid-Induced Osteoporosis 102
3.5 Assessment of Vitamin D Status 103
3.6 Requirements and Reference Intakes 104
3.6.1 Toxicity of Vitamin D 105
3.6.2 Pharmacological Uses of Vitamin D 106

4 Vitamin E: Tocopherols and Tocotrienols 109

4.1 Vitamin E Vitamers and Units of Activity 109
4.2 Metabolism of Vitamin E 113
4.3 Metabolic Functions of Vitamin E 115
4.3.1 Antioxidant Functions of Vitamin E 116
4.3.1.1 Prooxidant Actions of Vitamin E 118
4.3.1.2 Reaction of Tocopherol with Peroxynitrite 119
4.3.2 Nutritional Interactions Between Selenium and Vitamin E 120
4.3.3 Functions of Vitamin E in Cell Signaling 121
4.4 Vitamin E Deficiency 122
4.4.1 Vitamin E Deficiency in Experimental Animals 122
4.4.2 Human Vitamin E Deficiency 125
4.5 Assessment of Vitamin E Nutritional Status 125
4.6 Requirements and Reference Intakes 127
4.6.1 Upper Levels of Intake 128
4.6.2 Pharmacological Uses of Vitamin E 128
4.6.2.1 Vitamin E and Cancer 129
4.6.2.2 Vitamin E and Cardiovascular Disease 129

4.6.2.3 Vitamin E and Cataracts 129
4.6.2.4 Vitamin E and Neurodegenerative Diseases 129

5 Vitamin K 131
5.1 Vitamin K Vitamers 132
5.2 Metabolism of Vitamin K 133
5.2.1 Bacterial Biosynthesis of Menaquinones 135
5.3 The Metabolic Functions of Vitamin K 135
5.3.1 The Vitamin K-Dependent Carboxylase 136
5.3.2 Vitamin K-Dependent Proteins in Blood Clotting 139
5.3.3 Osteocalcin and Matrix Gla Protein 141
5.3.4 Vitamin K-Dependent Proteins in Cell Signaling – Gas6 142
5.4 Vitamin K Deficiency 142
5.4.1 Vitamin K Deficiency Bleeding in Infancy 143
5.5 Assessment of Vitamin K Nutritional Status 143
5.6 Vitamin K Requirements and Reference Intakes 145
5.6.1 Upper Levels of Intake 145
5.6.2 Pharmacological Uses of Vitamin K 146

6 Vitamin B_1 – Thiamin 148
6.1 Thiamin Vitamers and Antagonists 148
6.2 Metabolism of Thiamin 150
6.2.1 Biosynthesis of Thiamin 153
6.3 Metabolic Functions of Thiamin 153
6.3.1 Thiamin Diphosphate in the Oxidative Decarboxylation of Oxoacids 154
6.3.1.1 Regulation of Pyruvate Dehydrogenase Activity 155
6.3.1.2 Thiamin-Responsive Pyruvate Dehydrogenase Deficiency 156
6.3.1.3 2-Oxoglutarate Dehydrogenase and the γ-Aminobutyric Acid (GABA) Shunt 156
6.3.1.4 Branched-Chain Oxo-acid Decarboxylase and Maple Syrup Urine Disease 158
6.3.2 Transketolase 159
6.3.3 The Neuronal Function of Thiamin Triphosphate 159
6.4 Thiamin Deficiency 161
6.4.1 Dry Beriberi 161
6.4.2 Wet Beriberi 162
6.4.3 Acute Pernicious (Fulminating) Beriberi – Shoshin Beriberi 162
6.4.4 The Wernicke–Korsakoff Syndrome 163
6.4.5 Effects of Thiamin Deficiency on Carbohydrate Metabolism 164
6.4.6 Effects of Thiamin Deficiency on Neurotransmitters 165
6.4.6.1 Acetylcholine 165
6.4.6.2 5-Hydroxytryptamine 165
6.4.7 Thiaminases and Thiamin Antagonists 166

6.5 Assessment of Thiamin Nutritional Status 167
6.5.1 Urinary Excretion of Thiamin and Thiochrome 167
6.5.2 Blood Concentration of Thiamin 167
6.5.3 Erythrocyte Transketolase Activation 168
6.6 Thiamin Requirements and Reference Intakes 169
6.6.1 Upper Levels of Thiamin Intake 169
6.6.2 Pharmacological Uses of Thiamin 169

7 Vitamin B_2 – Riboflavin 172

7.1 Riboflavin and the Flavin Coenzymes 172
7.2 The Metabolism of Riboflavin 175
7.2.1 Absorption, Tissue Uptake, and Coenzyme Synthesis 175
7.2.2 Riboflavin Binding Protein 177
7.2.3 Riboflavin Homeostasis 178
7.2.4 The Effect of Thyroid Hormones on Riboflavin Metabolism 178
7.2.5 Catabolism and Excretion of Riboflavin 179
7.2.6 Biosynthesis of Riboflavin 181
7.3 Metabolic Functions of Riboflavin 183
7.3.1 The Flavin Coenzymes: FAD and Riboflavin Phosphate 183
7.3.2 Single-Electron-Transferring Flavoproteins 184
7.3.3 Two-Electron-Transferring Flavoprotein Dehydrogenases 185
7.3.4 Nicotinamide Nucleotide Disulfide Oxidoreductases 185
7.3.5 Flavin Oxidases 186
7.3.6 NADPH Oxidase, the Respiratory Burst Oxidase 187
7.3.7 Molybdenum-Containing Flavoprotein Hydroxylases 188
7.3.8 Flavin Mixed-Function Oxidases (Hydroxylases) 189
7.3.9 The Role of Riboflavin in the Cryptochromes 190
7.4 Riboflavin Deficiency 190
7.4.1 Impairment of Lipid Metabolism in Riboflavin Deficiency 191
7.4.2 Resistance to Malaria in Riboflavin Deficiency 192
7.4.3 Secondary Nutrient Deficiencies in Riboflavin Deficiency 193
7.4.4 Iatrogenic Riboflavin Deficiency 194
7.5 Assessment of Riboflavin Nutritional Status 196
7.5.1 Urinary Excretion of Riboflavin 196
7.5.2 Erythrocyte Glutathione Reductase (EGR) Activation Coefficient 197
7.6 Riboflavin Requirements and Reference Intakes 197
7.7 Pharmacological Uses of Riboflavin 198

8 Niacin 200

8.1 Niacin Vitamers and Nomenclature 201
8.2 Niacin Metabolism 203
8.2.1 Digestion and Absorption 203
8.2.1.1 Unavailable Niacin in Cereals 203
8.2.2 Synthesis of the Nicotinamide Nucleotide Coenzymes 203

8.2.3 Catabolism of NAD(P) 205
8.2.4 Urinary Excretion of Niacin Metabolites 206
8.3 The Synthesis of Nicotinamide Nucleotides from Tryptophan 208
8.3.1 Picolinate Carboxylase and Nonenzymic Cyclization to Quinolinic Acid 210
8.3.2 Tryptophan Dioxygenase 211
8.3.2.1 Saturation of Tryptophan Dioxygenase with Its Heme Cofactor 211
8.3.2.2 Induction of Tryptophan Dioxygenase by Glucocorticoid Hormones 211
8.3.2.3 Induction Tryptophan Dioxygenase by Glucagon 212
8.3.2.4 Repression and Inhibition of Tryptophan Dioxygenase by Nicotinamide Nucleotides 212
8.3.3 Kynurenine Hydroxylase and Kynureninase 212
8.3.3.1 Kynurenine Hydroxylase 213
8.3.3.2 Kynureninase 213
8.4 Metabolic Functions of Niacin 214
8.4.1 The Redox Function of NAD(P) 214
8.4.1.1 Use of NAD(P) in Enzyme Assays 215
8.4.2 ADP-Ribosyltransferases 215
8.4.3 Poly(ADP-ribose) Polymerases 217
8.4.4 cADP-Ribose and Nicotinic Acid Adenine Dinucleotide Phosphate (NAADP) 219
8.5 Pellagra – A Disease of Tryptophan and Niacin Deficiency 221
8.5.1 Other Nutrient Deficiencies in the Etiology of Pellagra 222
8.5.2 Possible Pellagragenic Toxins 223
8.5.3 The Pellagragenic Effect of Excess Dietary Leucine 223
8.5.4 Inborn Errors of Tryptophan Metabolism 224
8.5.5 Carcinoid Syndrome 224
8.5.6 Drug-Induced Pellagra 225
8.6 Assessment of Niacin Nutritional Status 225
8.6.1 Tissue and Whole Blood Concentrations of Nicotinamide Nucleotides 226
8.6.2 Urinary Excretion of N^1-Methyl Nicotinamide and Methyl Pyridone Carboxamide 226
8.7 Niacin Requirements and Reference Intakes 227
8.7.1 Upper Levels of Niacin Intake 228
8.8 Pharmacological Uses of Niacin 229

9 Vitamin B_6 232

9.1 Vitamin B_6 Vitamers and Nomenclature 233
9.2 Metabolism of Vitamin B_6 234
9.2.1 Muscle Pyridoxal Phosphate 236
9.2.2 Biosynthesis of Vitamin B_6 236
9.3 Metabolic Functions of Vitamin B_6 236
9.3.1 Pyridoxal Phosphate in Amino Acid Metabolism 237
9.3.1.1 α-Decarboxylation of Amino Acids 239

9.3.1.2 Racemization of the Amino Acid Substrate 241
9.3.1.3 Transamination of Amino Acids (Aminotransferase Reactions) 241
9.3.1.4 Steps in the Transaminase Reaction 242
9.3.1.5 Transamination Reactions of Other Pyridoxal Phosphate Enzymes 243
9.3.1.6 Transamination and Oxidative Deamination Catalyzed by Dihydroxyphenylalanine (DOPA) Decarboxylase 243
9.3.1.7 Side-Chain Elimination and Replacement Reactions 244
9.3.2 The Role of Pyridoxal Phosphate in Glycogen Phosphorylase 244
9.3.3 The Role of Pyridoxal Phosphate in Steroid Hormone Action and Gene Expression 245
9.4 Vitamin B_6 Deficiency 246
9.4.1 Enzyme Responses to Vitamin B_6 Deficiency 247
9.4.2 Drug-Induced Vitamin B_6 Deficiency 249
9.4.3 Vitamin B_6 Dependency Syndromes 250
9.5 The Assessment of Vitamin B_6 Nutritional Status 250
9.5.1 Plasma Concentrations of Vitamin B_6 251
9.5.2 Urinary Excretion of Vitamin B_6 and 4-Pyridoxic Acid 251
9.5.3 Coenzyme Saturation of Transaminases 252
9.5.4 The Tryptophan Load Test 252
9.5.4.1 Artifacts in the Tryptophan Load Test Associated with Increased Tryptophan Dioxygenase Activity 253
9.5.4.2 Estrogens and Apparent Vitamin B_6 Nutritional Status 254
9.5.5 The Methionine Load Test 255
9.6 Vitamin B_6 Requirements and Reference Intakes 256
9.6.1 Vitamin B_6 Requirements Estimated from Metabolic Turnover 256
9.6.2 Vitamin B_6 Requirements Estimated from Depletion/Repletion Studies 257
9.6.3 Vitamin B_6 Requirements of Infants 259
9.6.4 Toxicity of Vitamin B_6 259
9.6.4.1 Upper Levels of Vitamin B_6 Intake 260
9.7 Pharmacological Uses of Vitamin B_6 261
9.7.1 Vitamin B_6 and Hyperhomocysteinemia 261
9.7.2 Vitamin B_6 and the Premenstrual Syndrome 262
9.7.3 Impaired Glucose Tolerance 262
9.7.4 Vitamin B_6 for Prevention of the Complications of Diabetes Mellitus 263
9.7.5 Vitamin B_6 for the Treatment of Depression 264
9.7.6 Antihypertensive Actions of Vitamin B_6 264
9.8 Other Carbonyl Catalysts 265
9.8.1 Pyruvoyl Enzymes 266
9.8.2 Pyrroloquinoline Quinone (PQQ) and Tryptophan Tryptophylquinone (TTQ) 266
9.8.3 Quinone Catalysts in Mammalian Enzymes 268

10 Folate and Other Pterins and Vitamin B_{12} 270
10.1 Folate Vitamers and Dietary Folate Equivalents 271
10.1.1 Dietary Folate Equivalents 271
10.2 Metabolism of Folates 273
10.2.1 Digestion and Absorption of Folates 273
10.2.2 Tissue Uptake and Metabolism of Folate 274
10.2.2.1 Poly-γ-glutamylation of Folate 275
10.2.3 Catabolism and Excretion of Folate 276
10.2.4 Biosynthesis of Pterins 276
10.3 Metabolic Functions of Folate 279
10.3.1 Sources of Substituted Folates 279
10.3.1.1 Serine Hydroxymethyltransferase 279
10.3.1.2 Histidine Catabolism 281
10.3.1.3 Other Sources of One-Carbon Substituted Folates 283
10.3.2 Interconversion of Substituted Folates 283
10.3.2.1 Methylene-Tetrahydrofolate Reductase 284
10.3.2.2 Disposal of Surplus One-Carbon Fragments 286
10.3.3 Utilization of One-Carbon Substituted Folates 286
10.3.3.1 Thymidylate Synthetase and Dihydrofolate Reductase 287
10.3.3.2 Dihydrofolate Reductase Inhibitors 288
10.3.3.3 The dUMP Suppression Test 289
10.3.4 The Role of Folate in Methionine Metabolism 289
10.3.4.1 The Methyl Folate Trap Hypothesis 291
10.3.4.2 Hyperhomocysteinemia and Cardiovascular Disease 292
10.4 Tetrahydrobiopterin 294
10.4.1 The Role of Tetrahydrobiopterin in Aromatic Amino Acid Hydroxylases 294
10.4.2 The Role of Tetrahydrobiopterin in Nitric Oxide Synthase 296
10.5 Molybdopterin 297
10.6 Vitamin B_{12} Vitamers and Nomenclature 298
10.7 Metabolism of Vitamin B_{12} 300
10.7.1 Digestion and Absorption of Vitamin B_{12} 300
10.7.2 Plasma Vitamin B_{12} Binding Proteins and Tissue Uptake 301
10.7.3 Bacterial Biosynthesis of Vitamin B_{12} 303
10.8 Metabolic Functions of Vitamin B_{12} 303
10.8.1 Methionine Synthetase 304
10.8.2 Methylmalonyl CoA Mutase 305
10.8.3 Leucine Aminomutase 306
10.9 Deficiency of Folic Acid and Vitamin B_{12} 307
10.9.1 Megaloblastic Anemia 308
10.9.2 Pernicious Anemia 308
10.9.3 Neurological Degeneration in Vitamin B_{12} Deficiency 309
10.9.4 Folate Deficiency and Neural Tube Defects 310
10.9.5 Folate Deficiency and Cancer Risk 311
10.9.6 Drug-Induced Folate Deficiency 312
10.9.7 Drug-Induced Vitamin B_{12} Deficiency 313

10.10 Assessment of Folate and Vitamin B_{12} Nutritional Status 313
10.10.1 Plasma and Erythrocyte Concentrations of Folate and Vitamin B_{12} 314
10.10.2 The Schilling Test for Vitamin B_{12} Absorption 315
10.10.3 Methylmalonic Aciduria and Methylmalonic Acidemia 316
10.10.4 Histidine Metabolism – the FIGLU Test 316
10.10.5 The dUMP Suppression Test 317
10.11 Folate and Vitamin B_{12} Requirements and Reference Intakes 318
10.11.1 Folate Requirements 318
10.11.2 Vitamin B_{12} Requirements 318
10.11.3 Upper Levels of Folate Intake 319
10.12 Pharmacological Uses of Folate and Vitamin B_{12} 321

11 Biotin (Vitamin H) 324
11.1 Metabolism of Biotin 324
11.1.1 Bacterial Synthesis of Biotin 327
11.1.1.1 The Importance of Intestinal Bacterial Synthesis of Biotin 329
11.2 The Metabolic Functions of Biotin 329
11.2.1 The Role of Biotin in Carboxylation Reactions 330
11.2.1.1 Acetyl CoA Carboxylase 330
11.2.1.2 Pyruvate Carboxylase 331
11.2.1.3 Propionyl CoA Carboxylase 331
11.2.1.4 Methylcrotonyl CoA Carboxylase 332
11.2.2 Holocarboxylase Synthetase 332
11.2.2.1 Holocarboxylase Synthetase Deficiency 332
11.2.3 Biotinidase 334
11.2.3.1 Biotinidase Deficiency 335
11.2.4 Enzyme Induction by Biotin 335
11.2.5 Biotin in Regulation of the Cell Cycle 336
11.3 Biotin Deficiency 337
11.3.1 Metabolic Consequences of Biotin Deficiency 338
11.3.1.1 Glucose Homeostasis in Biotin Deficiency 338
11.3.1.2 Fatty Liver and Kidney Syndrome in Biotin-Deficient Chicks 338
11.3.1.3 Cot Death 339
11.3.2 Biotin Deficiency In Pregnancy 340
11.4 Assessment of Biotin Nutritional Status 340
11.5 Biotin Requirements 341
11.6 Avidin 341

12 Pantothenic Acid 345
12.1 Pantothenic Acid Vitamers 345
12.2 Metabolism of Pantothenic Acid 346
12.2.1 The Formation of CoA from Pantothenic Acid 348
12.2.1.1 Metabolic Control of CoA Synthesis 349

12.2.2 Catabolism of CoA 350
12.2.3 The Formation and Turnover of ACP 350
12.2.4 Biosynthesis of Pantothenic Acid 351
12.3 Metabolic Functions of Pantothenic Acid 352
12.4 Pantothenic Acid Deficiency 353
12.4.1 Pantothenic Acid Deficiency in Experimental Animals 353
12.4.2 Human Pantothenic Acid Deficiency – The Burning Foot Syndrome 354
12.5 Assessment of Pantothenic Acid Nutritional Status 355
12.6 Pantothenic Acid Requirements 355
12.7 Pharmacological Uses of Pantothenic Acid 356

13 Vitamin C (Ascorbic Acid) 357

13.1 Vitamin C Vitamers and Nomenclature 358
13.1.1 Assay of Vitamin C 359
13.2 Metabolism of Vitamin C 359
13.2.1 Intestinal Absorption and Secretion of Vitamin C 361
13.2.2 Tissue Uptake of Vitamin C 361
13.2.3 Oxidation and Reduction of Ascorbate 362
13.2.4 Metabolism and Excretion of Ascorbate 363
13.3 Metabolic Functions of Vitamin C 364
13.3.1 Dopamine β-Hydroxylase 365
13.3.2 Peptidyl Glycine Hydroxylase (Peptide α-Amidase) 366
13.3.3 2-Oxoglutarate–Linked Iron-Containing Hydroxylases 367
13.3.4 Stimulation of Enzyme Activity by Ascorbate In Vitro 369
13.3.5 The Role of Ascorbate in Iron Absorption and Metabolism 369
13.3.6 Inhibition of Nitrosamine Formation by Ascorbate 370
13.3.7 Pro- and Antioxidant Roles of Ascorbate 371
13.3.7.1 Reduction of the Vitamin E Radical by Ascorbate 371
13.3.8 Ascorbic Acid in Xenobiotic and Cholesterol Metabolism 371
13.4 Vitamin C Deficiency – Scurvy 372
13.4.1 Anemia in Scurvy 373
13.5 Assessment of Vitamin C Status 374
13.5.1 Urinary Excretion of Vitamin C and Saturation Testing 374
13.5.2 Plasma and Leukocyte Concentrations of Ascorbate 374
13.5.3 Markers of DNA Oxidative Damage 376
13.6 Vitamin C Requirements and Reference Intakes 376
13.6.1 The Minimum Requirement for Vitamin C 376
13.6.2 Requirements Estimated from the Plasma and Leukocyte Concentrations of Ascorbate 378
13.6.3 Requirements Estimated from Maintenance of the Body Pool of Ascorbate 378
13.6.4 Higher Recommendations 379
13.6.4.1 The Effect of Smoking on Vitamin C Requirements 380

13.6.5 Safety and Upper Levels of Intake of Vitamin C 380
13.6.5.1 Renal Stones 380
13.6.5.2 False Results in Urine Glucose Testing 381
13.6.5.3 Rebound Scurvy 381
13.6.5.4 Ascorbate and Iron Overload 382
13.7 Pharmacological Uses of Vitamin C 382
13.7.1 Vitamin C in Cancer Prevention and Therapy 382
13.7.2 Vitamin C in Cardiovascular Disease 383
13.7.3 Vitamin C and the Common Cold 383

14 Marginal Compounds and Phytonutrients 385

14.1 Carnitine 385
14.1.1 Biosynthesis and Metabolism of Carnitine 386
14.1.2 The Possible Essentiality of Carnitine 388
14.1.3 Carnitine as an Ergogenic Aid 388
14.2 Choline 389
14.2.1 Biosynthesis and Metabolism of Choline 389
14.2.2 The Possible Essentiality of Choline 391
14.3 Creatine 392
14.4 Inositol 393
14.4.1 Phosphatidylinositol in Transmembrane Signaling 394
14.4.2 The Possible Essentiality of Inositol 394
14.5 Taurine 396
14.5.1 Biosynthesis of Taurine 396
14.5.2 Metabolic Functions of Taurine 398
14.5.2.1 Taurine Conjugation of Bile Acids 398
14.5.2.2 Taurine in the Central Nervous System 398
14.5.2.3 Taurine and Heart Muscle 399
14.5.3 The Possible Essentiality of Taurine 399
14.6 Ubiquinone (Coenzyme Q) 400
14.7 Phytonutrients: Potentially Protective Compounds in Plant Foods 401
14.7.1 Allyl Sulfur Compounds 401
14.7.2 Flavonoids and Polyphenols 402
14.7.3 Glucosinolates 403
14.7.4 Phytoestrogens 404

Bibliography 409

Index 463

List of Figures

1.1. Derivation of reference intakes of nutrients. 22
1.2. Derivation of requirements or reference intakes for children. 24
1.3. Derivation of reference intake (RDA) and tolerable upper level (UL) for a nutrient. 25
2.1. Major physiologically active retinoids. 32
2.2. Major dietary carotenoids. 34
2.3. Oxidative cleavage of β-carotene by carotene dioxygenase. 41
2.4. Potential products arising from enzymic or nonenzymic symmetrical or asymmetric oxidative cleavage of β-carotene. 44
2.5. Role of retinol in the visual cycle. 51
2.6. Interactions of all-*trans*- and 9-*cis*-retinoic acids (and other active retinoids) with retinoid receptors. 56
2.7. Retinoylation of proteins by retinoyl CoA. 59
2.8. Retinoylation of proteins by 4-hydroxyretinoic acid. 60
3.1. Vitamin D vitamers. 78
3.2. Synthesis of calciol from 7-dehydrocholesterol in the skin. 81
3.3. Metabolism of calciol to yield calcitriol and 24-hydroxycalcidiol. 84
4.1. Vitamin E vitamers. 110
4.2. Stereochemistry of α-tocopherol. 112
4.3. Reaction of tocopherol with lipid peroxides. 114
4.4. Resonance forms of the vitamin E radicals. 117
4.5. Role of vitamin E as a chain-perpetuating prooxidant. 118
4.6. Reactions of α- and γ-tocopherol with peroxynitrite. 119
5.1. Vitamin K vitamers. 132
5.2. Reaction of the vitamin K-dependent carboxylase. 137
5.3. Intrinsic and extrinsic blood clotting cascades. 140
6.1. Thiamin and thiamin analogs. 149
6.2. Reaction of the pyruvate dehydrogenase complex. 154
6.3. GABA shunt as an alternative to α-ketoglutarate dehydrogenase in the citric acid cycle. 157

6.4. Role of transketolase in the pentose phosphate pathway. 160
7.1. Riboflavin, the flavin coenzymes and covalently bound flavins in proteins. 173
7.2. Products of riboflavin metabolism. 180
7.3. Biosynthesis of riboflavin in fungi. 182
7.4. One- and two-electron redox reactions of riboflavin. 184
7.5. Reaction of glutathione peroxidase and glutathione reductase. 186
7.6. Drugs that are structural analogs of riboflavin and may cause deficiency. 195
8.1. Niacin vitamers, nicotinamide and nicotinic acid, and the nicotinamide nucleotide coenzymes. 202
8.2. Synthesis of NAD from nicotinamide, nicotinic acid, and quinolinic acid. 204
8.3. Metabolites of nicotinamide and nicotinic acid. 207
8.4. Pathways of tryptophan metabolism. 209
8.5. Redox function of the nicotinamide nucleotide coenzymes. 215
8.6. Reactions of ADP-ribosyltransferase and poly(ADP-ribose) polymerase. 216
8.7. Reactions catalyzed by ADP ribose cyclase. 220
9.1. Interconversion of the vitamin B_6 vitamers. 233
9.2. Reactions of pyridoxal phosphate-dependent enzymes with amino acids. 238
9.3. Transamination of amino acids. 241
9.4. Tryptophan load test for vitamin B_6 status. 248
9.5. Methionine load test for vitamin B_6 status. 255
9.6. Quinone catalysts. 267
10.1. Folate vitamers. 272
10.2. Biosynthesis of folic acid and tetrahydrobiopterin 277
10.3. One-carbon substituted tetrahydrofolic acid derivatives. 280
10.4. Sources and uses of one-carbon units bound to folate. 281
10.5. Reactions of serine hydroxymethyltransferase and the glycine cleavage system. 281
10.6. Catabolism of histidine – basis of the FIGLU test for folate status. 282
10.7. Reaction of methylene-tetrahydrofolate reductase. 284
10.8. Synthesis of thymidine monophosphate. 287
10.9. Metabolism of methionine. 290
10.10. Role of tetrahydrobiopterin in aromatic amino acid hydroxylases. 295
10.11. Reaction of nitric oxide synthase. 297
10.12. Vitamin B_{12}. 299
10.13. Reactions of propionyl CoA carboxylase and methylmalonyl CoA mutase. 305
11.1. Metabolism of biotin. 325
11.2. Biotin metabolites. 326

11.3. Biosynthesis of biotin. 328
12.1. Pantothenic acid and related compounds and coenzyme A. 346
12.2. Biosynthesis of coenzyme A. 347
12.3. Biosynthesis of pantothenic acid. 351
13.1. Vitamin C vitamers. 358
13.2. Biosynthesis of ascorbate. 360
13.3. Redox reactions of ascorbate. 363
13.4. Synthesis of the catecholamines. 365
13.5. Reactions of peptidyl glycine hydroxylase and peptidyl hydroxyglycine α-amidating lyase. 366
13.6. Reaction sequence of prolyl hydroxylase. 368
14.1. Reaction of carnitine acyltransferase. 386
14.2. Biosynthesis of carnitine. 387
14.3. Biosynthesis of choline and acetylcholine. 390
14.4. Catabolism of choline. 391
14.5. Synthesis of creatine. 392
14.6. Formation of inositol trisphosphate and diacylglycerol. 395
14.7. Pathways for the synthesis of taurine from cysteine. 397
14.8. Ubiquinone. 400
14.9. Allyl sulfur compounds allicin and alliin. 402
14.10. Major classes of flavonoids. 403
14.11. Glucosinolates. 404
14.12. Estradiol and the major phytoestrogens. 405

List of Tables

1.1. The Vitamins 3
1.2. Compounds that Were at One Time Assigned Vitamin Nomenclature, But Are Not Considered to Be Vitamins 5
1.3. Marginal Compounds that Are (Probably) Not Dietary Essentials 6
1.4. Compounds that Are Not Dietary Essentials, But May Have Useful Protective Actions 7
1.5. Reference Nutrient Intakes of Vitamins, U.K., 1991 13
1.6. Population Reference Intakes of Vitamins, European Union, 1993 14
1.7. Recommended Dietary Allowances and Acceptable Intakes for Vitamins, U.S./Canada, 1997–2001 15
1.8. Recommended Nutrient Intakes for Vitamins, FAO/WHO, 2001 16
1.9. Terms that Have Been Used to Describe Reference Intakes of Nutrients 21
1.10. Toxicity of Vitamins: Upper Limits of Habitual Consumption and Tolerable Upper Limits of Intake 26
1.11. Labeling Reference Values for Vitamins 27
2.1. Prevalence of Vitamin A Deficiency among Children under Five 61
2.2. WHO Classification of Xerophthalmia 63
2.3. Biochemical Indices of Vitamin A Status 65
2.4. Reference Intakes of Vitamin A 67
2.5. Prudent Upper Levels of Habitual Intake 69
3.1. Nomenclature of Vitamin D Metabolites 79
3.2. Plasma Concentrations of Vitamin D Metabolites 80
3.3. Genes Regulated by Calcitriol 90
3.4. Plasma Concentrations of Calcidiol, Alkaline Phosphatase, Calcium, and Phosphate as Indices of Nutritional Status 104
3.5. Reference Intakes of Vitamin D 105
4.1. Relative Biological Activity of the Vitamin E Vitamers 111
4.2. Responses of Signs of Vitamin E or Selenium Deficiency to Vitamin E, Selenium, and Synthetic Antioxidants in Experimental Animals 123

4.3. Indices of Vitamin E Nutritional Status 126
5.1. Reference Intakes of Vitamin K 146
6.1. Indices of Thiamin Nutritional Status 168
6.2. Reference Intakes of Thiamin 170
7.1. Tissue Flavins in the Rat 176
7.2. Urinary Excretion of Riboflavin Metabolites 181
7.3. Reoxidation of Reduced Flavins in Flavoprotein Oxidases 187
7.4. Reoxidation of Reduced Flavins in Flavin Mixed-Function Oxidases 190
7.5. Indices of Riboflavin Nutritional Status 196
7.6. Reference Intakes of Riboflavin 198
8.1. Indices of Niacin Nutritional Status 227
8.2. Reference Intakes of Niacin 228
9.1. Pyridoxal Phosphate-Catalyzed Enzyme Reactions of Amino Acids 237
9.2. Amines Formed by Pyridoxal Phosphate-Dependent Decarboxylases 240
9.3. Transamination Products of the Amino Acids 242
9.4. Vitamin B_6-Responsive Inborn Errors of Metabolism 250
9.5. Indices of Vitamin B_6 Nutritional Status 251
9.6. Reference Intakes of Vitamin B_6 258
10.1. Adverse Effects of Hyperhomocysteinemia 293
10.2. Indices of Folate and Vitamin B_{12} Nutritional Status 315
10.3. Reference Intakes of Folate 319
10.4. Reference Intakes of Vitamin B_{12} 320
11.1. Abnormal Urinary Organic Acids in Biotin Deficiency and Multiple Carboxylase Deficiency from Lack of Holo-carboxylase Synthetase or Biotinidase 333
13.1. Vitamin C-Dependent 2-Oxoglutarate–linked Hydroxylases 367
13.2. Plasma and Leukocyte Ascorbate Concentrations as Criteria of Vitamin C Nutritional Status 375
13.3. Reference Intakes of Vitamin C 377

ONE

The Vitamins

The vitamins are a disparate group of compounds; they have little in common either chemically or in their metabolic functions. Nutritionally, they form a cohesive group of organic compounds that are required in the diet in small amounts (micrograms or milligrams per day) for the maintenance of normal health and metabolic integrity. They are thus differentiated from the essential minerals and trace elements (which are inorganic) and from essential amino and fatty acids, which are required in larger amounts.

The discovery of the vitamins began with experiments performed by Hopkins at the beginning of the twentieth century; he fed rats on a defined diet providing the then known nutrients: fats, proteins, carbohydrates, and mineral salts. The animals failed to grow, but the addition of a small amount of milk to the diet both permitted the animals to maintain normal growth and restored growth to the animals that had previously been fed the defined diet. He suggested that milk contained one or more "accessory growth factors" – essential nutrients present in small amounts, because the addition of only a small amount of milk to the diet was sufficient to maintain normal growth and development.

The first of the accessory food factors to be isolated and identified was found to be chemically an amine; therefore, in 1912, Funk coined the term *vitamine*, from the Latin vita for "life" and amine, for the prominent chemical reactive group. Although subsequent accessory growth factors were not found to be amines, the name has been retained – with the loss of the final "-e" to avoid chemical confusion. The decision as to whether the word should correctly be pronounced "vitamin" or "veitamin" depends in large part on which system of Latin pronunciation one learned – the *Oxford English Dictionary* permits both.

During the first half of the twentieth century, vitamin deficiency diseases were common in developed and developing countries. At the beginning of the twenty-first century, they are generally rare, although vitamin A deficiency (Section 2.4) is a major public health problem throughout the developing world, and there is evidence of widespread subclinical deficiencies of vitamins B_2 (Section 7.4) and B_6 (Section 9.4). In addition, refugee and displaced populations (some 20 million people according to United Nations estimates in 2001) are at risk of multiple B vitamin deficiencies, because the cereal foods used in emergency rations are not usually fortified with micronutrients [Food and Agriculture Organization/World Health Organization (FAO/WHO, 2001)].

1.1 DEFINITION AND NOMENCLATURE OF THE VITAMINS

In addition to systematic chemical nomenclature, the vitamins have an apparently illogical system of accepted trivial names arising from the history of their discovery (Table 1.1). For several vitamins, a number of chemically related compounds show the same biological activity, because they are either converted to the same final active metabolite or have sufficient structural similarity to have the same activity.

Different chemical compounds that show the same biological activity are collectively known as *vitamers*. Where one or more compounds have biological activity, in addition to individual names there is also an approved generic descriptor to be used for all related compounds that show the same biological activity.

When it was realized that milk contained more than one accessory food factor, they were named A (which was lipid-soluble and found in the cream) and B (which was water-soluble and found in the whey). This division into fat- and water-soluble vitamins is still used, although there is little chemical or nutritional reason for this, apart from some similarities in dietary sources of fat-soluble or water-soluble vitamins. Water-soluble derivatives of vitamins A and K and fat-soluble derivatives of several of the B vitamins and vitamin C have been developed for therapeutic use and as food additives.

As the discovery of the vitamins progressed, it was realized that "Factor B" consisted of a number of chemically and physiologically distinct compounds. Before they were identified chemically, they were given a logical series of alphanumeric names: B_1, B_2, and so forth. As can be seen from Table 1.2, a number of compounds were assigned vitamin status, and were later shown either not to be vitamins, or to be compounds that had already been identified and given other names.